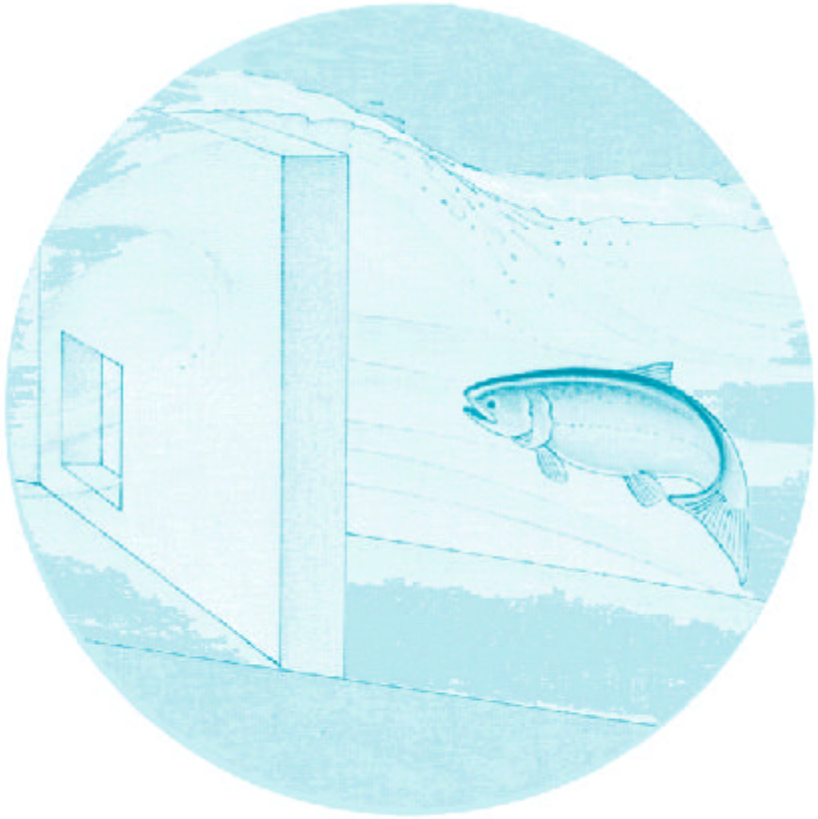
March 1990

EXECUTIVE SUMMARY: PRELIMINARY DESIGN REPORT FOR THE YAKIMA/KLICKITAT PROOUCTION PROJECT



DOE/BP-00245-1

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views of this report are the author's and do r necessarily represent the views of BPA.

This document should be cited as follows:

Bonneville Power Administration Division of Fish and Wild life, 26 electronic pages (BPA Report DOE/BP-00245-1)

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A master plan for the Yakima/Klickitat Production Project (YKPP) was developed by the Northwest Power Planning Council (Council) on October 15, 1987, as a reasonable basis upon which the Bonneville Power Administration (BPA) could proceed to fund predesign work on the project. The Council approved the predesign work on the condition that eight preliminary tasks were completed. These tasks are:

Task 1. Agreement on a refined statement of project goals.

Task 2. Completion of a technical analysis of water supplies.

Task 3. Completion of an experimental design plan.

Task 4. Development of a harvest management plan.

Task 5. Assessment of potential genetic risks.

Task 6. Project coordination with all other affected parties.

Task 7. Submission of a preliminary design report to the Council.

Task 8. Develop a project management structure.

The preliminary design report summarizes the work completed on these tasks. It provides a description of the preliminary design, engineering, and construction phases of project development, and gives an estimate of project costs. Also included is a description of other studies that were conducted to support YKPP planning.

The results of studies conducted during the last 30 months indicate that hatchery facilities can be built in the Yakima and Klickitat subbasins to provide harvest benefits and to supplement natural production. Planning for the Yakima subbasin is at a more advanced stage of development than for the Klickitat subbasin because of greater availability of basic resource information. The information needed to proceed with final design and construction for the Klickitat subbasin will be available by 1992, as ongoing predesign work continues. This schedule is consistent with the anticipated phased completion of the YKPP by 1997.

Three general types of facilities are planned for the YKPP. One or more central hatchery facilities will be built in each subbasin for adult holding, egg incubation, and juvenile rearing. Clusters of standardized ponds will be constructed by streams targeted for supplementation, where juvenile fish will be acclimated before being released. Some adult and juvenile trapping facilities already exist and are operating in the Yakima subbasin, additional facilities are needed in both subbasins. These facilities will be used for broodstock collection and for sampling upstream and downstream migrants.

COORDINATION AND CONSULTATION

Extensive coordination is required for the YKPP because of the complexity of the technical issues, the number of public and private interest groups involved, and because of the wide geographical area over which fish will be produced and ultimately harvested. BPA has developed a number of coordination and consultation activities for the project. For example, BPA has developed a Public Involvement Plan, with inputs from technical working groups (TWGs), to involve interest groups and individuals in the Yakima and Klickitat subbasins with project planning. The TWGs are comprised of representatives of various Council work groups, including those involved in fish health protection, the Monitoring and Evaluation Group (MEG), supplementation, and subbasin planning. These representatives coordinate TWG issues with the various Council groups. Additionally, a task team for coordination activities consults with other interested parties.

The Yakima Indian Nation (YIN) has appointed a project manager to interface with the BPA project manager and the project leader. The project TWG meets monthly to review the technical progress and to recommend action or submit questions to the project managers and various task teams. Task teams are subcommittees of the Hatchery Effectiveness TWG (HE-TWG), and are responsible for progress in coordination, water analysis, tributary issues, experimental design, disease strategies, engineering, environmental issues, and the sockeye reintroduction feasibility study. Task team efforts are coordinated with the system-wide TWGs, specifically the MEG, the Supplementation TWG, the HE-TWG, and the Fish Health Protection Committee (FHPC).

The Experimental Design Work Group (EDWG) provides coordination for the biological aspects of the YKPP. Its coordination role includes assuring consistency between project goals and scientific activities and communicating biological requirements to the management entities and technical groups. The EDWG is also responsible for coordinating YKPP research activities with other fishery programs within the Yakima and Klickitat subbasins, and system-wide within the Columbia Basin. Note, however, that the fundamental role of EDWG is not coordination and consultation, but the establishment of standards for experimental design and data analysis.

Public information and involvement began with the development of the Council's Yakima and Klickitat Rivers Central Outplanting Facility Master Plan. This report involved BPA, the Council, the YIN, state and federal management agencies, Yakima Irrigation Districts, and others. Various interest groups were contacted informally during implementation of the predesign study to discuss the project and related issues. The formal coordination process with the general public has included meetings with landowners, sports groups, irrigation districts, and other special interest groups. Coordination activitie-s with sport fishing groups dealt primarily with concerns regarding potential impacts to rainbow trout above Roza Dam and on distinctions between wild and hatchery stocks of steelhead in the Klickitat system. Coordination activities were also initiated with individuals owning land contiguous with tributary streams. A Tributary Task Team was established to meet with landowners in an effort to resolve problems currently limiting salmon and steelhead production in tributaries.

Yakima/Klickitat Production Project newsletters have been distributed by BPA and management agencies. Feature articles in the Yakima Basin Resource News and the BPA Backarounder were distributed to the public to provide background information on the project and current status of planning efforts. BPA has also produced several videos and coordinated press releases on the project for public information.

PROJECT MANAGEMENT STRUCTURE

The BPA is serving as the overall project manager for the YKPP and has responsibility for schedules, contracts, and submitting the Preliminary Design

Report to the Council. The project is managed from the BPA Yakima Project Office in Yakima, Washington. A project leader acts on behalf of the management entities to coordinate efforts of the fishery managers, and to identify the policy issues which require resolution by the appropriate decisionmakers.

A YKPP TWG was formed in late 1987 and is composed of experts in hatchery production, natural production, harvest management, and fish health. Technical work group members also serve on other system work groups such as the System Operating Advisory Committee, the MEG, the Fish Health Protection Committee, the HE-TWG, the Supplementation TWG, and the Subbasin Planning Group. The YKPP TWG is further split into task teams that provide technical guidance in specific areas.

The fisheries managers have created a policy-level review group comprised of representatives of the YIN, the Washington Department of Fisheries (WDF) and the Washington Department of Wildlife (WDW). This group resolves policy issues which relate to production, harvest, and genetics, as well as policy issues identified by the TWG. Policy-level attention will be required for the life of the project.

REFINED PROJECT GOALS

A refined statement of project goals was jointly developed by the YIN, the WDF, and the WDW. In establishing these goals and objectives, the managers also endorsed the adaptive management policy adopted by the Council for the YKPP. This approach recognizes that achievement of stated objectives is subject to uncertainty, and that strategies must be evaluated and revised in the light of new information.

The purpose of the YKPP is to supplement and enhance natural production of salmon and steelhead stocks in the Yakima and Klickitat subbasins, not to replace natural production. Accordingly, spawning and rearing habitat should continue to be protected and enhanced. The Yakima and Klickitat Subbasin Plans focus on habitat enhancement in a general sense. Planned YKPP programs are fully compatible with these subbasin plans, but do not assume or require that they be implemented. However, any measure, including those in the

subbasin plans, that enhances natural production will increase the effectiveness of the YKPP.

The YKPP proposes to enhance existing stocks while preserving their basic character, adaptability, and fitness. The best adapted stocks will be introduced in cases where the species is no longer present. The success of the project requires the critical uncertainties be systematically investigated by controlled scientific experiments. Four categories of population responses have been identified, in terms of which alternative supplementation strategies will be evaluated. They are:

1. The post-release survival of hatchery-reared fish.
2. The homing and reproductive success of supplemented populations.
3. The long-term fitness of supplemented populations.
4. The inter- and intra-specific interactions (including competition, predation and genetic effects) between supplemented and unsupplemented populations.

Supplementation strategies (treatments) hypothesized to affect these responses will be administered in the context of controlled experiments. Factors not varied experimentally will be kept constant'by means of quality control programs and/or monitored. Hatchery practices are not considered a critical uncertainty, and will therefore be managed as experimental constants.

The YKPP includes eight different stocks: spring, summer, and fall chinook salmon, coho salmon, sockeye salmon, and steelhead trout in the Yakima subbasin; and spring chinook salmon and steelhead trout in the Klickitat subbasin. The relative emphasis supplementation objectives place on natural versus hatchery production varies by stock, ranging from primarily natural, in the case of Yakima spring chinook, to primarily hatchery, in the case of Yakima coho. Supplementation opportunities may indeed vary within a stock, depending on the outcome of ongoing substock identification work.

The YKPP proposes to increase both the production potential and the stock status of targeted stocks. Production and harvest potential will be enhanced by increasing the number of smolts (and thus adults) produced per spawner. This increase in productivity will be a consequence of the egg-to-smolt survival advantage of hatchery rearing experienced by a portion of each

run. The central hypothesis of the YKPP is that a significant part of this advantage can be sustained through the natural lifecycle (survival-to-adult, natural spawning and production of fit offspring).

A goal closely associated with the goal of increased productivity is the goal of improving the "status" of supplemented stocks. "Stock status" refers to abundance in relationship to carrying capacity or, roughly, to the level of "seeding." The goal of the YKPP is to increase and maintain stocks at levels permitting or approaching "maximum sustained yield" (MSY). Maximum sustained yield stock status is achieved when sustainable surplus production--production in excess of that needed for population replacement--is maximized. It should be noted that management of the Yakima and Klickitat subbasins will require somewhat lower exploitation rates and sustainable surplus production than MSY if it becomes necessary to protect a weak substock (e.g., if unsupplemented substocks cannot sustain MSY harvest).

Adult production objectives for the YKPP are derived from and are expressed in terms consistent with the Council's System Planning Model. The approach is based on the expected long term production of adult equivalents under a maximum sustained harvest policy. The adult equivalency computations include prior harvest and are expressed as adults entering the subbasin.

A major element of this project is the conservation of genetic population characteristics currently found in the wild and natural salmonid populations of the Yakima and Klickitat subbasins. Six of the more important strategies intended to minimize adverse genetic impacts on natural populations are as follows:

1. Identification and separate culture of distinct substocks which are to be outplanted in the ancestral drainages only.

2. Marking all hatchery juveniles and using only unmarked adults as broodstock.

3. Collection of no more than 20% of the return of a given stock for broodstock.

4. Implementation of mating schemes that maximize genetic diversity of offspring.

5. Reduction or elimination of hatchery practices that subject fish to unnatural selection pressures.

6. Establishment and continual monitoring of unsupplemented control streams, and the comparison of trends in abundance and genetic indices of supplemented and unsupplemented "subpopulations" within the same stock.

It is important to note that a genetic monitoring and evaluation program will be developed by EDWG to assess the project's central goal of increasing harvest and enhancing long-term productivity without adverse genetic impacts.

HARVEST MANAGEMENT PLAN

A harvest management plan for the YKPP was developed jointly by the WDF, the WDW, and the YIN. Information from the Pacific Salmon Commission, the Pacific Fisheries Management Council, members of the Columbia River Compact, and comments of public interest groups were considered in development of the plan.

The general framework of the plan balances competing needs for tributary harvest, natural stock escapement, genetic resource conservation, and hatchery broodstock. Relatively conservative harvest rates are imposed at low stock abundance to accelerate rebuilding while permitting moderate harvest opportunities for treaty and nontreaty fisheries. The harvest plans also reflect a strong commitment by state and tribal managers to control harvests so natural and hatchery broodstock requirements can be met and to ensure that natural escapements are sufficiently large to permit evaluation of supplementation experiments.

All Yakima and Klickitat stocks are subject to harvest in ocean and in-river fisheries. Present policy suggests that increases in ocean interceptions above current rates are unlikely. Impacts of in-riuer fisheries on YKPP fish will depend largely on changes in production of other stocks, and whether fisheries continue to be managed for aggregate escapement goals.

Fall chinook salmon and coho are the two primary stocks expected to contribute to ocean and mainstem fisheries. Steelhead do not contribute significantly to ocean fisheries, but will contribute to treaty commercial and non-treaty recreational fisheries in the mainstem Columbia River. The contribution of spring chinook to all ocean fisheries is thought to be less

than 10% of the run and increased production as a result of the YKPP is unlikely to significantly affect mainstem harvest levels. Summer chinook are not expected to be subjected to high rates of harvest in the ocean or the mainstem Columbia River.

The framework for treaty/non-treaty allocation of spring chinook has been developed, and will likely be used for other stocks of interest (i.e., steelhead). Species-specific harvest plans will be implemented jointly by the managers. The managers will also explore and develop methods to forecast stock returns to the terminal areas and develop sampling programs to track the progress of terminal fisheries toward specified harvest goals.

The following text summarizes terminal harvest goals for the eight stocks to be managed under the YKPP.

Yakima Spring Chinook

Only 20% of naturally-produced spring chinook adults may be taken for hatchery broodstock to safeguard genetic resources. Accordingly, the broodstock goal of 970 adults will be met at run sizes exceeding 6,000 fish. Harvest rates are fixed on runs up to 12,000 to obtain a range of escapements above the interim goal.

Yakima Summer Steelhead

Recreational fisheries in the Yakima River are currently designed to harvest most hatchery steelhead, while reserving wild/natural fish for spawning. An incidental steelhead harvest would occur in tribal dipnet fisheries because fall chinook and coho enter the river with summer steelhead. The hatchery broodstock goal of 240 naturally-produced adults will be met at run sizes in excess of 2,525 fish. The interim natural escapement goal of 9,000 adults will be achieved at runs of about 10,250. Terminal harvest rates will be restricted until the interim natural escapement goal is reached.

Yakima Fall Chinook

The broodstock goal of 1,070 will be met at natural escapements greater than 1,780 from runs exceeding 2,250 fish. The interim natural escapement goal of 10,000 adults will be achieved with runs of 13,800. Terminal harvest rates for all fisheries are 20% on runs greater than or less than 13,800.

Yakima Summer Chinook

A harvest management plan will be developed for terminal fisheries as production plans for this stock become more certain.

Yakima Coho

The harvest plan for Yakima coho emphasizes terminal harvest of all coho in excess of hatchery needs. The broodstock collection goal of 2,350 adults will be met regardless of returning run size by importing surplus coho from other hatcheries if harvest and broodstock needs are not met. Terminal fisheries will be managed for 50% harvest rates on runs less then 4,700 and for all harvestable surplus on runs exceeding that number.

Yakima Sockeye

No harvest plans have been developed for this species pending feasibility studies.

Klickitat Spring Chinook

The hatchery broodstock goal of 2,900 adults will be met at run sizes of about 4,150 fish. A natural escapement goal will be agreed upon once better information is available on passage and production potential. Harvest rates for all terminal fisheries will not exceed 30% until the natural escapement goal is met.

Klickitat Summer Steelhead

Recreational steelhead fisheries are designed to harvest most hatchery steelhead while reserving wild/natural fish for spawning. An incidental steelhead harvest will occur in target fisheries on fall chinook and coho. Under YKPP supplementation goals, adipose-clipped steelhead will spawn naturally to rebuild the natural stock to MSY levels. Accordingly, harvest rates on adipose-clipped steelhead will not exceed 55% in all terminal fisheries during the rebuilding phase. The hatchery broodstock goal of 350 adults will be met at natural escapement of 3,500 adults from runs of about 4,100 fish. The interim goal will be reviewed once better information is available about passage and production capacity (by 1992). Terminal harvest rates will be restricted until the interim natural escapement goal is reached.

EXPERIMENTAL DESIGN PLAN

The YKPP will help determine what role supplementation should have in rebuilding production in the Columbia Basin. This help will consist of new knowledge about supplementation benefits, constraints, costs, and procedures. An annual, integrated course of pre-facility planning will continue through 1995 for the Yakima system, when hatchery operation and experimentation are is expected to begin. The pre-facility planning schedule for the Klickitat system will continue through 1997. Implicit communication links in the planning cycle ensure the coordination of YKPP activities with other fisheries research and management groups in the Columbia Basin. These links include regular meetings, external peer-review of products, and participation of members of the YKPP's EDWG in the system wide planning processes (e.g., the Supplementation TWG and the Council's MEG). Although implementation of the experimental plan is envisioned in 5-year cycles, review and modifications, based on experimental results, will occur on an annual basis.

The basic goal of the YKPP is to enhance stocks of salmon and steelhead through hatchery supplementation, but to not create separate hatchery and natural populations with irreconcilable harvest and escapement needs. No less important are the goals of increasing productivity in the Yakima and Klickitat subbasins, and the experimental goal of providing new knowledge of supplementation applicable in other Columbia River tributaries. The success of supplementation is founded on a set of four operating assumptions that are to some degree justified by current knowledge. These assumptions are:

1. Hatchery fish will survive and return to the target spawning areas at rates equal to substantial fractions of estimated natural rates.
2. Supplemented populations will successfully reproduce.
3. Supplemented populations will maintain fitness over the long term.
4. Inter- and intra-specific interactions can be managed to avoid unintended effects.

Hatchery practices must be carefully standardized in order to avoid experimental confounds. Therefore, rigid guidelines for hatchery operations will be developed and observed. It should be clearly noted that hatchery practices are not treated as an experimental variable.

The experimental design is an iterative process using knowledge gained at each step to refine future actions. Each iteration of the experimental program design will involve the following basic steps: identification of critical uncertainties, identification of appropriate response variables, and modification of previous uncertainties and hypotheses based upon results of the experimental program.

The central experimental hypothesis of the YKPP will be evaluated against criteria in the four primary population response categories: 1) post-release survival of hatchery fish, 2) reproductive success of supplemented populations, 3) long-term fitness of supplemented populations, and 4) inter- and intra-specific interactions.

Post-release survival is defined as survival from time of release until fish return to spawn. It is important that post-release survival be high enough that the advantages attributable to artificial incubation and rearing are not offset. Survival within a subbasin of both supplemented and natural smolts has been identified as a critical uncertainty in this category, and is being addressed in pre-facility work at the present time. The standard against which post-release survival will be assessed is the survival of natural fish.

Reproductive success is defined as the number of offspring produced per spawner in a supplemented population. The relative reproductive success of hatchery, mixed ("hybrid"), and natural matings is a critical uncertainty.

In the context of the YKPP, a "fit" population is one that maintains its genetic identity and diversity. The maintenance of fitness of supplemented populations over the long term is a critical uncertainty. In order for fitness to be maintained, existing substocks will be identified and appropriate broodstock collection practices will be developed and implemented.

Species interactions consist of the effects supplemented populations have on a species of interest. Measurable components of species interactions include population abundance and distribution, growth rates, carrying capacity, survival rates, and gene flow. In particular, interaction between supplemented populations of steelhead trout and resident rainbow trout has been identified as a critical uncertainty.

A monitoring program is being developed to measure responses of salmonids in the Yakima and Klickitat subbasins to supplementation activities. Responses are measured in terms of survival by life stage (post-release survival), reproductive success, long-term fitness (genetics monitoring), and interaction effects. The response variables that must be measured include:

- Survival of fish from release through outmigration.
- Contribution to major fisheries.
- Adult returns to the subbasin.
- Spawning.

Development of appropriate methods for monitoring these characteristics is a primary goal of the pre-facility experimental program. Response variables for studies of the genetic effects of supplementation, intra-specific and inter-specific interactions, and stock assessment must be identified and coordinated within the monitoring program. Sampling rates, locations, schedules, and procedures will be further refined as current baseline data collection studies provide more information and as research needs are further refined.

PRELIMINARY ENGINEERING WORK PLAN

Preliminary design studies were conducted to provide plans for construction of salmon and steelhead facilities in the Yakima and Klickitat subbasins. These studies will guide TWGs and design engineers in final project design and construction. The nature and location of various fish-production facilities were consistent with the Yakima and Klickitat Rivers Central Outplanting Facility Master Plan, and the Report on Refined Project Goals and Management Plan for the YKPP. Participants in planning included BPA, the YIN, the WDW, the WDF, the U.S. Bureau of Reclamation (USBR), outside experts in fish hatchery design/culture, and the consulting engineers. Specific production goals and other requirements were developed with input from the EDWG.

Water quality guidelines used for YKPP fish culture facilities were originally developed by the Alaska Department of Fish and Game. Disease control ‘criteria were incorporated into hatchery design, and addressed methods

and facilities for incubation, rearing, and adult holding. Flow rates were estimated from calculations on flow and space requirements by species. These flow rates were compared with available flows as reported in the Water Analysis Report.

The programming of each fish species by subbasin and facility was accomplished with the help of a computer program developed by Fish Management Consultants (FMC). This program calculates space, flow, and food requirements for the fish culture activities. Programming was based on a discrete number of experimental groups per targeted stock. Fish production schedules and the requirements for rearing and incubation of experimental groups were coordinated and carefully reviewed. Facilities were designed to accommodate all phases of the life-cycle of targeted stocks, including adult holding and spawning, incubation of eggs, rearing, food consumption, fish transportation, and manpower.

The Cle Elum site was chosen as the central hatchery facility for upper Yakima spring chinook. In addition, Naches spring chinook eggs will be moved from Oak Flats to this site after they reach the eyed stage, and will be incubated and reared here until being returned to Oak Flats as fingerlings. The Oak Flats site was chosen as the central hatchery facility for Naches spring and summer chinook, and all coho production. Some steelhead rearing will also occur on this site. The Nelson Springs central hatchery is located at the confluence of Buckskin Creek and Nelson Springs, and was selected as the central hatchery for fall chinook and summer steelhead. The Nelson Springs site will provide for adult holding, incubation, and rearing of summer steelhead and fall chinook.

Fifteen acclimation ponds in five clusters of three each were described for upper Yakima spring chinook in the plan developed by EDWG. The plan for acclimation of the Naches spring chinook included three clusters of two ponds each. The plan developed for summer steelhead includes six clusters of two ponds. A standardized acclimation pond was designed to accommodate the various experimental groups in the program.

The Klickitat facility is designed to meet the hatchery goal of enhancing spring chinook and summer steelhead. Cascade Springs is the planned

location for the central facility and will include operations for adult holding, spawning, egg incubation, rearing, and acclimation and release. Five alternative sites were considered for some form of facility development: White Creek, Summit Creek, Klickitat WDF Station, Wonder Springs, and Indian Ford Springs. Acclimation sites in the upper Klickitat subbasin may receive fish from the central facility for short-term holding and rearing prior to release. Potential sites for "trap-and-haul" programs include the Falls 5 Fishway, the WDF Klickitat Hatchery, and the Castile Falls Fishway. Water for the Klickitat Hatchery will come from three sources: Cascade Spring, Kidder Spring, and the Klickitat River.

PROJECT COST ESTIMATE

Total costs for the Yakima and Klickitat projects through March 1, 1990, were about $8,400,000. This value includes costs through FY-90 ($6,186,000) and current obligations for FY-90. The total costs estimated for construction of the Yakima River subbasin salmon and steelhead facilities (i.e., central hatcheries, satellite facilities, acclimation sites, adult and juvenile trapping facilities) is $31,434,000. An additional $500,000 has been estimated for land acquisition for the three central hatcheries and the two satellite sites. Land acquisition costs are not yet available for the acclimation sites or the adult and juvenile trapping facilities. The total cost for construction of the Klickitat facilities, including five acclimation sites and fees for design and construction engineering, legal, and administrative fees is estimated to be $9,040,000.

ANALYSIS OF WATER SUPPLIES

The USBR conducted an analysis of the adequacy of water supplies in the Yakima and Klickitat subbasins for increasing natural and artificial production of anadromous salmonids. This analysis, which was based on literature review and field studies, emphasized the following four areas:

1. Water quality and quantity for the proposed artificial production facilities and for mainstem reaches and tributaries supporting anadromous fish.
2. Accessibility and quality of existing anadromous fish habitat.

3. Existing constraints on anadromous fish production.

4. Classification of streams into three mutually exclusive production categories: currently suitable for anadromous production, suitable for anadromous production in the near term (less then 10 years) with improvements or new water use agreements, or unsuitable for anadromous production in the near term.

The water for instream flows in the Yakima River and for irrigation in the Yakima Valley is supplied by natural flows, groundwater, storage, and return flows. Instream flows are affected by storage reservoir operating schemes, irrigation diversions, irrigation return flows, hydroelectric plants, and pumping plants. Reservoirs provide storage water to irrigation districts, and return flows from irrigation systems in the upper valley provide much of the instream flows in the lower Yakima River during the irrigation season. In contrast, no major storage reservoirs have been constructed in the Klickitat subbasin and total diversions represent a small fraction of total runoff. It is not thought that instream flows limit anadromous fish production in the Klickitat subbasin because the runoff pattern is essentially natural.

The water supply analysis study team compiled data from five general areas: stream hydrology, stream description, facility water supplies, fish habitat, and water quality. Summary and analysis of streamflows was based on historic data, field measurements, and computer simulations of the Yakima River storage system. Information on fish habitat quantity and quality included data from instream flow methodology (IFIM analysis), descriptive field surveys, and information summarized in the Yakima and Klickitat Subbasin Plans. Estimates of the natural production potential of anadromous fish habitat in both subbasins were made using the standard smolt density method employed in subbasin planning.

Central hatchery facilities have been proposed for five sites in the Yakima subbasin (Prosser, Wapato Canal, Cle Elum, Oak Flats, Nelson Springs) and one site in the Klickitat subbasin (Cascade Springs). The quantity of surface water available is probably adequate for all sites.. Groundwater supplies need additional development at three of the sites.. Water quality parameters of some concern included temperature, metallic ions (especially

aluminum), chloride and nitrates. However, natural production does not appear to constrained by water quality.

Existing conditions in the lower Yakima River--the 47 miles from Prosser Dam to the Columbia River--could affect the production of all five stocks of salmonids to some degree, while conditions in tributary streams could affect one to four stocks. Except for the Naches system, no tributary of the Yakima River presently has the instream flows, accessibility, and habitat quality to realize its full production potential. Flow constraints are numerous and include low spring flows in the upper Yakima River that directly or indirectly kill newly-emergent fry; low spring flows in the middle river (below Sunnyside Dam) that exacerbate losses of outmigrating smolts; low winter flows in the Yakima Canyon that adversely affect overwinter survival; and summer flows throughout most of the drainage that are too high for optimal rearing. Potential water quality constraints include high temperatures in the lower river that could prevent passage and rearing, as well as elevated concentrations of chloride, nitrate, and metallic ions such as aluminum and manganese. However, these water quality problems are largely restricted to the lower river (specifically, the reach from Sunnyside Dam to the Columbia), and it is only in the lower river that they constrain the production of anadromous fish. Passage problems include adult migration barriers (primarily at impassible diversion dams on tributaries), hazards to juvenile migration (primarily in the form of unscreened or poorly screened irrigation diversions), and regions of low streamflow below larger irrigation diversions that impair passage of both adults and juveniles in several tributaries as well as the mainstem Yakima River. Most of the constraints to anadromous fish production in the Yakima subbasin can be reduced or eliminated with improvements.

There appears to be adequate streamflow and spring water quantities at the Cascade Springs site in the Klickitat subbasin to meet the projected fish facility needs. However, further investigation of the effects of elevated levels of metals in the river water on fish culture at the site is needed. The major constraints to anadromous fish production in the Klickitat subbasin are adult passage and flow. The two major passage problems in the mainstem are Lyle Falls (river mile 2.2) and Castile Falls (river mile 64.2).

Steelhead, spring chinook, and coho are the primary stocks affected. Several falls block access to tributaries in the Klickitat River. Low seasonal flows also restrict rearing of anadromous fish in a number of tributary streams. Most tributaries in the Klickitat subbasin are not suitable for supplementation because of limited production potential. Water quality (i.e., sediment loading) is a problem in the Klickitat River downstream of the Big Muddy Creek confluence at river mile 53.8. Provision of adult passage facilities at Lyle and Castile Falls was identified as improvement projects with the largest potential of increasing anadromous salmonid production in the Klickitat subbasin.

In 1989, the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), and the YIN began investigations to determine the incidence and geographic distribution of significant salmonid parasites and pathogens that could affect the proposed supplementation program. The presence of some common salmonid pathogens has already been established within the Yakima and Klickitat watersheds. However, the tribe and agencies will use the latest and best available husbandry and disease prevention techniques in attempts to minimize mortality from fish diseases. Several operational plans have been designed to reduce the impact of infectious diseases, including vaccination of broodstock, separate incubation of egg batches, and isolation of water supplies during holding periods. Fish husbandry and health practices recommended by the Pacific Northwest Fish Health Protection Committee (PNFHPC) will be followed and activities coordinated with the WDF, the WDW, and the YIN to assure that all fish and gametes brought into the subbasins and/or released from central outplanting facilities meet state standards designed to reduced the incidence and spread of disease.

GENETIC RISK ASSESSMENT

A preliminary genetic risk assessment was conducted for the YKPP by the WDF. The document follows many basic concepts for genetic risk assessment currently being developed by the Council's MEG, but will be revised as risk assessment tools and a standard format become available. A fundamental informational need for genetic risk assessment is knowledge of the substock structure of target species and runs, and this information is not yet

available for the YKPP. Extensive sampling of chinook and steelhead in both subbasins for substock identification research began in 1989. YKPP operations will be revised as information from direct experimentation or from population sampling becomes known.

Current genetic risk assessment planning by the MEG has identified three types of genetic risk: 1) extinction, 2) loss of within-population variability, and 3) loss of population identity. Extinction is the most extreme type of risk and can be caused by any activity that reduces a population below a minimum viable level. Loss of within-population variability is commonly associated with hatchery production. Type 2a risk is loss of variability due to genetic drift and is the most common type of genetic risk imposed by hatcheries. Type 2b risk is loss of variability due to non-random sampling of a population in collecting broodstock and can also occur in hatchery populations. Loss of between-population variability or loss of population identity happens when stocks are mixed during broodstock collection and egg taking, or if straying occurs. Domestication selection is a fourth type of genetic risk that needs to be considered in assessing the impact of hatchery operations on salmon and steelhead.

Genetic risk can be minimized by careful management of fisheries and hatchery operations. The risk of extinction can be minimized by managing for terminal harvest. Weak substocks can be protected by restricting terminal harvests in the light of various indices of substock abundance, such as coded-wire tag recoveries or genetic stock identification (GSI) data. The key to controlling loss of within-population variability is an accurate estimation of effective population size. Random collection of fish for broodstock will help to limit loss of variability due to "founder effects." Loss of population identity can be minimized by determining the geographic distribution of targeted stocks, and by restricting outplants to ancestral areas. Domestication selection can be minimized by reducing or eliminating hatchery practices that impose artificial selection pressures.

The commitment of YKPP planners to minimizing genetic risk is illustrated by the fact that the entire project is designed as an experiment, the central hypothesis of which is " . . new artificial production in the Yakima and Klickitat subbasins can be used to increase harvest and to enhance

natural production without adversely affecting genetic resources." Thus, certain genetic conservation protocols are built into the YKPP.

Substock identification has been identified as a critical YKPP pre-facility research activity. The intent is to characterize electrophoretic and scale patterns for all major spawning aggregations of pre-existing stocks targeted for supplementation. This includes spring chinoook and summer steelhead in the Yakima and Klickitat Rivers, and fall chinook in the Yakima River. Klickitat winter steelhead will also be sampled.

Broodstock management will be designed to minimize genetic risk. Returning adults will be taken randomly at appropriate collection sites, and effective population size will be maximized in the hatcheries. Caps will be set on the maximum proportion (of annual run size) of discrete stocks that can be collected for broodstock. Stock mixing in the hatcheries will be eliminated by culturing different stocks in separate containers. All hatchery reared fish will be marked and excluded from broodstock collections to minimize risk of domestication selection. Development of improved broodstock management techniques has been designated a critical pre-facility need.

Long-term monitoring is required to assess the success of the genetic conservation effort. YKPP stocks will be periodically reanalyzed electrophoretically to examine genetic change at structural gene loci over time. Observed gene frequency fluctuation in supplemented populations will be compared with theoretical values based on the effective population size of the natural population. Detailed fitness comparisons between hatchery and wild fish will be based on measurements of several survival and reproductive traits.

American River spring chinook and Satus Creek summer steelhead will not be supplemented because they have little or no hatchery ancestry and, in the case of American River spring chinook, because they represent a genetic type unique in the Columbia Basin. Thus, Satus Creek and the American River will be managed as "genetic refuges" for these two stocks. Management may eventually include construction of weirs across the streams to restrict entry of strays.

Genetic risk assessments are provided in the predesign report for targeted stocks as well as for nontargeted stocks that may be genetically impacted. Discussion of non-target stocks is limited to rainbow and cutthroat trout. Other fish populations which do not interbreed with YKPP production stocks, but which may be displaced, are not discussed.

ECONOMIC ANALYSIS

The proposed YKPP will have major impacts on the economies of the project area. During the construction phase economic flows will arise from spending on materials, services, and labor. Upon completion of this phase of the program, expenditures associated with sport and treaty harvests will cycle through the local economies. A biological monitoring and experimentation program will also generate employment, spending, and income. Yakima and Kittitas Counties will experience the greatest economic impact because of the size and type of proposed hatchery facilities in the region, the size and nature of the local economies, and the interaction of economic flows.

A computer model of the local economies was used to simulate local economic interactions. Two complementary methodologies were used to estimate indirect and induced impacts of the YKPP. A modified version of IMPLAN (IMpact analysis for PLANning) model was initially used to simulate the linkages among the various industrial and commercial sectors of an economy. Impacts were developed for the construction and harvest time periods, and for each of three economic areas: the total project area, the Yakima subbasin, and the mid-Columbia/Klickitat subbasin. A regional econometric model was used to quantify the key linkages between employment, income, and spending in a region. The magnitude and extent of these linkages was estimated using historical data on the operation of the regional economy.

For the economic analyses, the program was divided into four major elements: construction, operation and maintenance, experimentation and monitoring, and harvest. Different estimation procedures were developed for the direct impacts stemming from each of the four categories of fishery enhancement activities. Construction expenditures were allocated into specific‘ industrial sectors and assigned to specific counties and years. Broad measures of aggregate project spending were allocated to industrial

sectors and specific counties to obtain direct expenditures resulting from operations, maintenance, and experimentation and monitoring. Direct expenditures resulting from harvest activities included both sport fishing and treaty fishing components.

The project was estimated to develop 6,975 person-years of employment, $132,424,280 of income, and $33,859,760 of taxable sales in the study area from 1990 through 2015. In a typical year during the construction phase, the study area was estimated to experience increases of 143 jobs, $4,036,856 in income, and $8,753,135 in output. The construction sector will experience the greatest change in output, whereas the service sector will experience the greatest increase in income and employment. In a peak harvest year, the study area will experience an estimated increase of 409 jobs, $8,507,806 in income, and $17,627,154 in output. The service and trade sectors are estimated to account for 82% of these changes.

An overall increase in total economic activity will be brought about by the YKPP. Timing of peak impact events include a construction period impact peak occurring in 1994, a harvest impact peak in 2015, and a slight dip in regional economic activity commencing in 1995 and ending with the third year of harvesting in 2000. A level of economic activity is expected to be 2.8 times as great in the peak harvest year as in the peak construction year.

Anticipated benefits include increased employment in areas generally suffering from high unemployment, stimulation of entrepreneurial activities in the study area, and a relatively steady increase in jobs and income. The new jobs will bring a mixed quality of employment to the region--high income employment will be associated with the construction, operations and maintenance, and experimentation and monitoring phases, while lower income employment will occur from service sector and trade activities during the harvest period.

The project is also predicted to aid in the structural evolution of the study area's economy. For example, gradual changes in sport fishing will induce increases in tourism. This shift into tourist-related activities will represent a new undertaking for much of the region. Examples of new

enterprises include marinas, tackle sales, guide services, and traditional hospitality industries.

A relatively steady building of jobs and income will occur because of the existence of continued operations and maintenance expenditures, and because the experimentation and monitoring expenditures will help balance reductions of construction expenditures. The addition of Phase II screening and enhancement construction will help to smooth the transition from hatchery construction activities. Additionally, increases in service sector activities during experimentation and monitoring will modulate impacts of the strong service sector that are expected during the harvest period.

ENVIRONMENTAL ASSESSMENT

The BPA prepared an Environmental Assessment (EA) in March 1990 for the YKPP as required by the National Environmental Protection Act (NEPA). The draft EA of June 1989 was submitted to the public for review and comment. The EA included several alternatives, including BPA's proposed action and a "no action" (i.e., no project will be built) alternative. The major issues of concern in the draft EA included potential effects of supplementation on resident trout populations in the upper Yakima River and on genetic diversity of existing stocks, effects of hatchery operations on water rights and water quality, and potential impacts of construction activities on important habitat (i.e., wetlands), sensitive wildlife species, and/or cultural resources. The EA provides a detailed analysis of these and other issues. Recommendations were made that included further monitoring and evaluation, identification of mitigation measures, and/or development of alternative locations for project implementation. The current enhancement scenario for the YKPP was based on the EA, the results of the engineering feasibility study, experimental design, and baseline data.